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A Safe Line Drawn Between Operative and
Non-Operative Cases.

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A SAFE LINE DRAWN BETWEEN OPERATIVE AND NON-OPERATIVE CASES.

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Of the several theories held by different observers as to the nature of Heterophoria neither one may be absolutely correct to the exclusion of the others. In some cases one theory may be correct; in other cases, another theory; and in another class of cases, a still different theory would be applicable.

A brief review of the different explanations of Heterophoria will not be out of place just here. One view is that there is a congenital feebleness of one muscle as compared with its opposing muscle, this weakness being due either to the fewness of the muscular fibers entering into its formation; or to its faulty attachment to the sclera, this in the weak muscle, being abnormally far from the corneo-scleral junction; or to a want of proper innervation. That there can be truth in this view no one can successfully deny. There can be no case of Heterophoria in which this theory will not explain some of the phenomena.

Another theory denies that Heterophoria is congenital. Its advocates teach that the development and growth of the ocular muscles have been normal, their attachments perfect and their nerve supply all that could be desired. They would teach us that some irritation in or about the eye, or in some organ remote from the eye, excites a spasm, tonic in its nature, in one of a pair of muscles, thus destroying their harmonious action. This spasm existing in the superior rectus would give hyperphoria; in the internal rectus, esophoria; in the external rectus, exophoria; in one of the obliques, a form of Heterophoria first described by the author of this paper.* This condition would certainly explain some of the phenomena seen in the examination of any case of Heterophoria, and will, therefore, always have its advocates.

* See Archives of Ophthal. Vol. xx, No. 1, 1891.

The third theory grants that congenitally the muscular apparatus of the eyes may be all right—just what is claimed by the advocates of theory No. 2, and yet it claims that the cause of Heterophoria is congenital, in that the maculae do not occupy corresponding places in the two retinae. A congenital displacement of the macula up or down in one eye would give hyperphoria; a congenital displacement of the macula, in one or both eyes, outward would give esophoria; and a similar displacement inward would give exophoria. This theory also includes the idea that an abnormal placing of the eyes in their orbits can cause Heterophoria. If one eye (and its orbit) occupies a lower plane than its fellow, there necessarily results a hyperphoria.

If any other theories for Heterophoria have been framed they have not come under my observation. Only two of these theories have before been published so far as I know, the third theory being an original deduction of my own and is here given for what it may be worth.

Something can be said for and against all of these views. Against all of them stands the one fact that, in many cases of horizontal Heterophoria, we have esophoria for distance and exophoria for near.

If asked which of the three I accept I would answer that I believe each one contains a germ of truth, and that, possibly, the conditions included in each co-exist in certain cases.

There may never be unanimity of opinion as to the nature of Heterophoria; but the concession that such a thing exists is already universal. Heterophoria having always had an existence will always continue to exist. In the not very remote past nothing was done for its relief because nothing was known of its existence. Oculists of to-day and of the future must combat this disturber of human comfort.

In order to reach a conclusion as to the form of Heterophoria, and the amount of same, in any given case, and how it should be dealt with, two or more of the several tests now known should be resorted to. In all cases it is my custom, after making a complete correction of any existing error of refraction, to resort to four muscle tests, and when these do not clear my mind of doubt, I try a fifth test. These will be explained in the order in

which I take them. The first is the Maddox rod test. Provided the lenses correcting the errors of focus are alike, the rod $\frac{3}{4}$ inch long, set in an opening, of corresponding length, through the center of a metal disc, is all that could be desired for this test. It can be readily seen that, if before one eye is a $+1.00$ and before the other a $+2.00$, a serious error could result in the test for vertical Heterophoria. The optical center of the lens is immediately behind the center of the $\frac{3}{4}$ inch rod. For $\frac{3}{8}$ of an inch above and below the optical center of the lens the streak of light can be seen, so that, in the case supposed above, there must be a partial or complete correction of an existing hyperphoria, or there must appear an artificial hyperphoria as a result of the difference in prismatic effect of the lenses, provided the axes of vision pass above or below the centers of the two lenses. To counteract this chance for error to creep in and result in bad practice, I conceived the idea of covering all the rod, by pasting paper over it, except $\frac{1}{8}$ inch of its center. If the streak is seen through this small opening it must be seen through (or very near) the optical center of the lens before that eye, and at the same time the blaze of the candle must be seen through the optical center of the lens before the fellow eye.

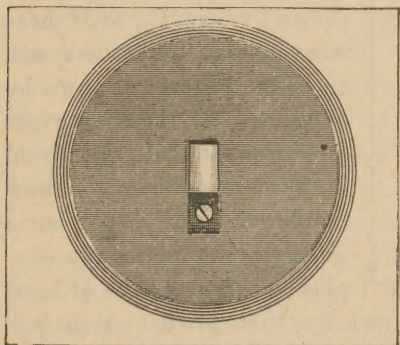


Fig. A.

The chance for error thus eliminated by this modification of the Maddox rod, (fig. A), this test may be resorted to with a considerable degree of confidence. With the lens or combination of lenses, needed for focal correction, placed in the posterior receptacle of the frames, the metal disc con-

taining the rod is placed in the anterior. The lighted candle or gas jet is 20 feet from the patient. The eye whose muscles are to be tested is always the one before which the rod is placed. Let it be the right eye first. The disc is placed vertically. The patient is asked to look at the candle, which he sees distinctly with his left eye; and, at the same time he sees a streak of light

running horizontally. The left eye is the one that is fixed. If there is vertical orthorhopia the streak will occupy position 2 in fig. B; if there is right hyperphoria the streak will occupy position 3 in fig. B., or if there is right cataphoria the streak will occupy position 1 in fig. B. The amount of vertical heterophoria is measured by that prism which will throw the streak when occupying positions 1 or 3 into position 2. When right hyperphoria is found, the left eye, when tested in the same way, will show the same degree of cataphoria. The condition of the superior and inferior recti having been thus determined, the disc must be revolved until the rod comes to the horizontal when the streak will become vertical. The

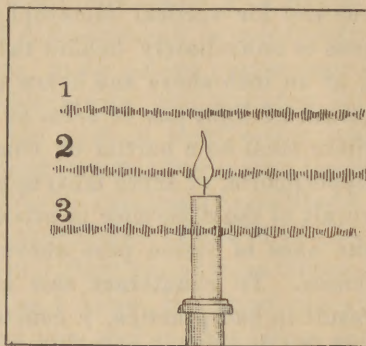


Fig. B.

right eye being first under test again, if there is horizontal orthorhopia the streak will be found in position 5 fig. C. if,

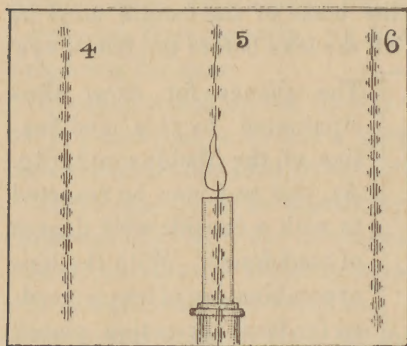


Fig. C.

there is esophoria the streak will go to the right as is shown by 6 fig. C.; or if there is exophoria the streak will go to the left as is shown by 4 fig. C. If there is right esophoria, the left eye tested in the same manner will show esophoria, and exophoria when there was right exophoria. The degree of hori-

zontal heterophoria is determined by that prism which will remove the streak from position 4 or 6 to position 5 in fig. C. The rod test resorted to in the way here described is trustworthy in that it does not show a condition that has no existence. By it we may not be able to judge of the necessity for an operation, if we are to be guided by the line which I will draw later between operative and non-operative

cases. If in any case we find 3 or more degrees of hyperphoria or 10 or more degrees of esophoria or exophoria we can safely conclude that the patient will be a subject for operation either immediately or remotely.

In further investigation of the case the rod is laid aside and the second means of testing is taken up. The Maddox double prism, or better my modification ² of same, is used. This is placed in the anterior division of test frames, as was the rod, and is so set as to double the candle seen by that eye and make the one in the same vertical plane with the other. While this is being done the fellow eye may be covered by an opaque disc. After the double images have been made and properly placed, the fellow eye is uncovered when at once a third candle comes into view. If there is orthophoria the third image will be in the same vertical plane with the other two and just half way between them. While in this method either eye may be considered as the one under test, it is my custom to take the one in which there is the single image. The double prism being before the right eye the left is then the one to be tested. The middle image going to the left there is left esophoria; going to the right, there is left exophoria; going nearer the lower blaze, there is left hyperphoria, going nearer to the upper blaze, there is left cataphoria. In the same manner the right eye may be tested. The degree of heterophoria is determined by the prism that places the middle image in line with the other two and equidistant from them. The double prism test readily shows any compound muscular error that may exist. To illustrate: there may be left esophoria and left hyperphoria, and when this is the case the middle blaze will not only go to the left of the vertical plane of the other two but it will also approach the horizontal plane of the lower light. The rod cannot, at the same moment, show the two conditions. Of the two tests I consider the rod the more reliable, though often they both are attended by like results.

In continuing the double prism test a card, on which there is

² This consists of two separate prisms 6° each bases toward each other and put in rim of same size as those containing lenses in test case, the line of the bases passing exactly through the center of rim.

drawn or printed a single horizontal line with a dot in its center, is held before the patient at the distance of sixteen inches. After placing an opaque disk before one eye, say the left one, while the double prism is allowed to remain before the other, the card is elevated or depressed until the patient sees two lines with equal distinctness, and the dots in the same vertical plane. On removing the disk from before the other eye a third line appears between the other two. If there is orthophoria the middle line will be equally distant from the other two and the three dots will be in the same vertical plane, as is shown in fig. D.

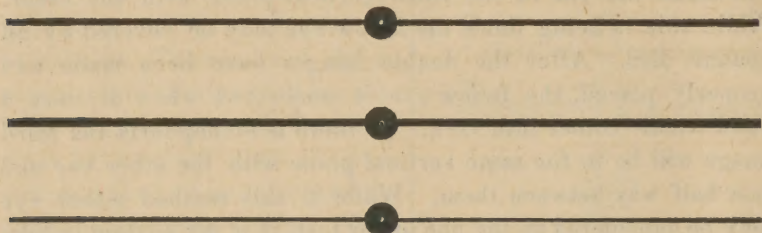


Fig. D.

If there is esophoria the middle dot will be found to the left of the vertical plane of the other two as shown by fig. E; if

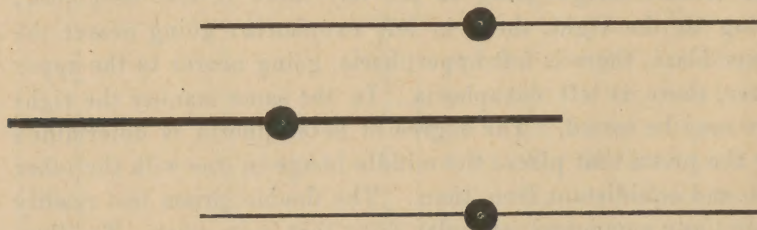


Fig. E.

exophoria, it will go to the right of this plane as is shown by fig. F. When a vertical error exists it is shown by the middle

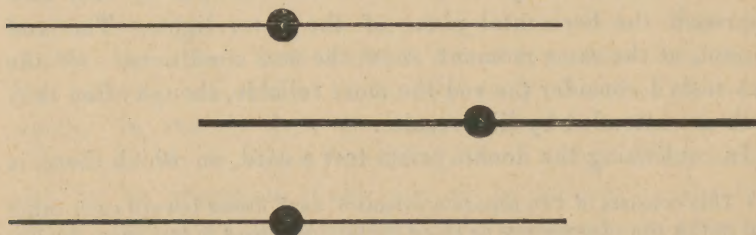


Fig. F.

line going towards the lower in hyperphoria, as in fig. G, or

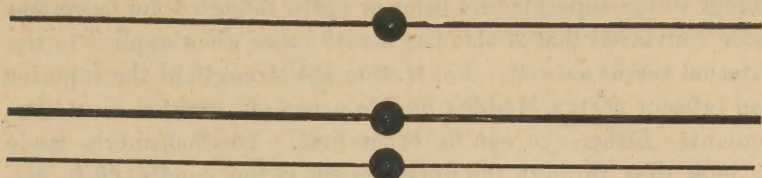


Fig. G.

towards the upper in cataphoria, as in fig. H. As in the distant

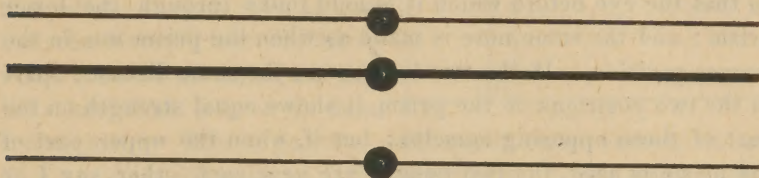


Fig. H.

test so in the near the existence of a compound error is shown at the one glance, by the middle line going to the right or left and approaching the top or bottom line.

In this near test with the double prism the same vertical heterophoria is shown as was manifested in the far test, but the degree of error manifested is usually a little more in the near than in the far test. If there is esophoria in the far test there is either a less degree of esophoria or, as is often the case, there is exophoria in the near. In only very few cases is esophoria greater in the near than in the far.

In both the near and the far test with the double prism the patient may see but two images, the vertical error being so great that the middle has blended with either the upper or the lower image. The result is easily reached by holding the opaque disc before first one eye and then the other. With the disc before the eye with the single image if the two lights or two lines are still seen it proves that the middle image was blended with one of the other two. By placing the disc now before the other eye—the one with the double image in it—the top line only is made to disappear, showing hyperphoria to exist in the fellow eye; or if the bottom line is the one to disappear the condition is shown to be cataphoria.

The third, in order, is the *strength* test. I rarely apply this except to the superior and inferior recti, though I am more and more convinced that it also has a real value when applied to the external rectus as well. For testing the strength of the superior and inferior recti a Maddox double prism (4° each) is most convenient. Either eye can be taken first. The patient is made to look first through the upper prism at the candle 20 ft. distant, and it is noted whether two lights, or one, are seen, and, if two, their distance apart. Now the double prism is elevated so that the eye before which it is held looks through the lower prism; and the same note is made as when the prism was in the former position. If the two images are the same distance apart in the two positions of the prism, it shows equal strength on the part of these opposing muscles; but if, when the upper part of the prism is used, the two images are near each other, say 1 or 2 inches apart, while they are 10 or more inches apart when the lower part of the prism is used, there is an excess of power in the superior rectus. The same test applied to the fellow eye would show an excess of power in the inferior rectus. This test is confirmatory of the two preceding tests, and much reliance can be placed in it.

As to the strength test of the external rectus the following is a good rule: if that muscle can overcome a prism of more than 8° there is exophoria; if less than 8° esophoria is to be suspected. A want of full abducting power may attend a latent and, therefore, uncorrected hyperphoria.

The fourth test is that by means of the plane deep red glass, nothing else being before the eyes except the lenses correcting focal errors. While in a large proportion of cases this test is negative, yet it is one most useful as will be presently shown. The image of the flame (20 feet distant) on the retina of the eye before which the red glass is placed is, of course, greatly modified as compared with the image in the fellow eye. If there is orthophoria, or if there is heterophoria of low or even of moderate degree, the images will be fused and only one blaze will be seen; but if there is heterophoria of high grade the images may not fuse and diplopia results, a red light being seen by one eye and a white light by the other. The patient is asked to fix the white

blaze, and at the same time observe the position of the red blaze and the distance between the two. Fig. I, illustrates the result brought about by this test. The bold, sharply defined candle (7) represents the white one, the pale candles above (8) and to the right (9) of the other represent the red candles. The red glass being first before the right eye the patient at once says he sees two candles, the red one being directly above the white, and that they are from 1 to 4 or more

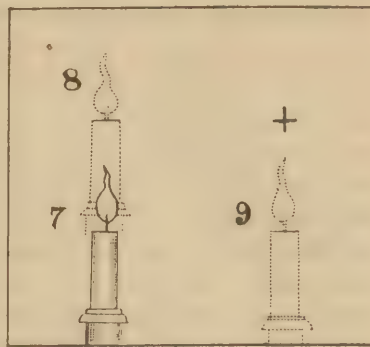


Fig. I.

inches apart. This is positive evidence of right cataphoria, or, if the term is objected to, left hyperphoria. The extent of the deviation is measured by that prism which will cause the images to fuse. If there is vertical orthophoria while, at the same time, there is horizontal heterophoria of high degree the red light (9) will appear in the same horizontal plane with the white one and they will be from one to many inches apart (in one of my cases they were 30 inches apart). If there is right esophoria the red candle will be to the right as in fig. I; if right exophoria, then, of course, the red candle would be to the left of the white one.

If a compound muscular error exists, the red glass in suitable cases will show it at a glance. The head being perfectly erect if there is right cataphoria and esophoria (the red glass before the right eye) the red light will be above and to the right of the white, occupying the position + in fig. I. In all of the cases of this class there is, without the interposition of the red glass, binocular single vision as can be most readily determined. Otherwise the test would be without value.

The fifth test is never resorted to when the fourth (the red glass test) results in diplopia; but in some cases responding to the first three tests the results are conflicting, especially as to the vertical heterophoria. To clear the doubt, if possible, a Maddox double prism (4° each), line of bases horizontal, is placed before one eye, while another double prism (6° each), line of bases vertical, is placed before the other eye. On looking in

the direction of the candle 20 feet distant, four candles are seen, two in a vertical plane and two in a horizontal plane. If there is orthophoria these planes will bisect each other, and the four candles will form a perfect diamond. If there is hyperphoria the horizontal plane will cut the vertical nearer the lower candle, sometimes passing through it. If there is a horizontal as well as a vertical heterophoria, the right image may run into the lower one the left one going further away but stopping in same horizontal plane with the latter. Two having gone into one but three images remain, and these form a right angle triangle. In some cases this test has enabled me to do correctly vertical decentering of lenses when the other tests would have led me to do nothing. Such cases require only a small amount of prismatic effect, $\frac{1}{4}$ to $\frac{1}{2}$ degree.

It must be confessed that in some cases after all known tests have been resorted to there still remains doubt as to what the true muscular condition is. In such cases it is best to do nothing.

In this paper I have not referred to the Stevens phorometer, one of the best, if not the very best, means of determining heterophoric conditions. The chief objection to it is its cost.

Having thus far discussed heterophoria and some of the tests that may be resorted for its determination I am ready to draw *a safe line between operative and non-operative cases*. On the *operative* side of the line must be placed all cases in which the plane red glass produces diplopia. On the *non operative* side of the line should be placed, at least for a time, all cases of heterophoria in which there is not diplopia when the plane red glass is before one eye. Prisms, or decentered lenses, in position of rest should always be resorted to primarily in all cases falling on the non-operative side of the line. In those cases in which the third theory for heterophoria, given in this paper, is the true one nothing but prisms placed as above will ever be needed. There are cases, however, in which the use of prisms gives only temporary relief, and their strength must be increased from time to time, until, finally, the red glass again tried shows that the patient must be transferred to the operative side of the line.

There are still other cases of heterophoria in which the red

glass will at no time cause diplopia; and yet these cases have not been relieved by prisms carefully chosen and properly placed. As a last means of relief operations must be resorted to.

At the first test a fair number of cases of heterophoria will fall on the operative side of our line; a little later, the wearing of prisms will place a larger number on the operative side where they properly belong; and later still, despairing of relief for certain of our patients by prisms, in spite of the absence of diplopia with the red glass, another contingent must be placed on the operative side of our line.

These three classes of cases will give us abundance of opportunities for dividing tendons and yet leave a considerable number of heterophoric patients enjoying the relief brought them by prisms.

In correcting muscular errors by means of prisms there is no infallible rule we can follow in determining the strength of the prism to be given. In my own practice I often give at once a full correction of the vertical error, but more often begin by giving a $\frac{1}{2}$ to $\frac{3}{4}$ correction and later, if the comfort experienced at first does not continue, give the full correction. Vertical prismatic effect of more than 2° for each eye should not be given, in fact this much is rarely ever demanded. If more than this is needed the red glass will usually develop a vertical diplopia when an operation should be done at once.

In esophoria I usually give about half the prismatic effect which would seem to be indicated. For instance, the patient has R. esoph. 8° , L. esoph. 8° . Thus it will be seen that an 8° prism would give a full correction, but instead of giving this much prismatic effect, which the eyes would not tolerate, I give only 4° correction by placing a prism of 2° , base out, before each eye. In exophoria a $\frac{1}{2}$ to $\frac{3}{4}$ correction should be given. In esophoria and exophoria prisms stronger than 3° should not be prescribed, because of chromatic aberration.

In giving prismatic effect, vertical or horizontal, I resort to decentration of lenses when possible. A little thought enables one in a moment to tell just how much any given lens must be decentered in order to get the desired amount of prismatic effect.

In operating on cases responding to the red glass test a fairly free division of the tendon of the strong muscle must be made. One or more fibres should be left above and below in order to prevent too great an effect both immediately and remotely. The guide as to when enough is done short of a complete division tendon is a fusion of the red and white lights. While operating the test should be resorted to, to show what effect has been gained by the cutting already done. In no case should the red light be made to cross to the opposite side of the white light as will nearly always be the case when the whole tendon has been severed. If a complete tenotomy is done accidentally or on purpose, an advancing stitch is nearly always necessary.

In cases demanding an operation when there is no response to the red glass test, the division of the tendon must be done with still greater care else an over-effect will result.

